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Comparative analysis of nutritional values of riverine and marine hilsa (*Tenualosa ilisha*; Hamilton, 1882)

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Abstract

A study was performed to analyze the biochemical composition (moisture, protein, fat, ash, salt value, iron, calcium and phosphorus) of raw and salted hilsa. Pure (with less than 1% impurities) and clean dry salt was used (fish weight : salt weight = 3 : 1) for salting the hilsa. The nutrients values of the hilsa from two different regions were significantly ($p < 0.05$) varied. The biochemical compositions were also different before and after the processing of the hilsa. Riverine hilsa contains relatively more moisture (57.79 ± 0.51%) and protein (15.65 ± 0.50%) than marine hilsa. Fat (16.39 ± 0.51%) and salt (1.80 ± 0.14%) contents are higher in marine hilsa; whereas the ash (7.88 ± 0.35%) content was higher in the riverine hilsa. Minerals like iron (4.92 ± 0.32 mg/100 g) and calcium (480.02 ± 6.73 mg/100 g) remain in large amounts in the marine hilsa, but the phosphorus (112.36 ± 4.40 mg/100 g) content remains at a high level in the riverine hilsa. In addition, the protein (raw condition, 18.54 ± 0.46%, riverine; 17.12 ± 0.42%, marine and salted condition, 32.54 ± 0.5%, riverine; 27.31 ± 0.48%, marine) and fat (raw condition, 15.41 ± 0.46%, riverine; 19.07 ± 0.51%, marine and salted condition, 11.58 ± 0.39%, riverine; 13.6 ± 0.55%, marine) contents were higher in the abdominal region of the riverine and marine hilsa both in the raw and salted conditions than in the head and caudal region.

Keywords : Riverine hilsa, marine hilsa, salted hilsa, nutritional values

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Introduction

Fisheries of Bangladesh provide 60% of animal protein; contribute 3.69% to GDP and 2.01% to foreign exchange earnings (DoF, 2015). More than 10% of the country's total fish production comes from hilsa and it contributes a total of about 346,512 MT (Inland 114,475 MT and Marine 232,037 MT) in 2011-12 (FRSS, 2013). Hilsa fish is a very popular and tasty fish among Bangladeshi people living at home and abroad. The hilsa fish is largely an anadromous species, but two other ecotypes - a fluvial

potamodromous type and a marine type - have been recognized. Biochemical composition of fish flesh may vary within the same species of fish depending upon the fishing season, age, sex and habitat (Srivastava, 1985; Shamim et al., 2011). The variation is also found within the different portion of the body (Jacquot, 1961; Mustafa et al., 2012). In fishes, proximate composition means the composition of the fish flesh. Fish flesh contains four basic ingredients in varying proportions major nutrients such as water (70 - 80%), protein (18 - 20%), fat (5%) and minerals (5%) and minor nutrients such as vitamin, carbohydrate (Khurseed and Mosharaff, 1998). It has high nutritional value in terms of fats and proteins that are not commonly available in other foods. The fish has been found to contain specialized type of fat having about 50% of unsaturated fatty acids out of which about 2% w-3 fatty acids exists (Rao et al., 1977). Hilsa fish contains different types of fatty acids and amino acids which are helpful for human (Mustafa et al., 2012). Moreover, it contains higher quality of Ca, P, Fe and Vitamin A, D including trace level of Vitamin B. Hilsa fish liver contains 120 IU of Vitamin A (Haldar et al., 2004). In terms of production and quality export Hilsa plays a significant role in the economy of Bangladesh.

There are some information on the sensory, biochemical and bacteriological studies of hilsa (Mansur et al., 1998). The biochemical and nutritional studies of some fresh water fish species (Uddin et al., 1977; Uddin et al., 1979; Rubbi et al., 1987) mentioned proximate composition of some commercial species of fresh water fish. The information on the chemical composition of fish in respect to the nutritive value is important to compare with other source of animal protein, meat and poultry products (Stansby, 1954). There are a few reports on the nutritive values of hilsa. Hilsa is a migratory fish and it travels thousands of kilometers from upstream of river to mid ocean. Different regions of the Bay of Bengal contains are different types of food (phytoplankton and zooplankton). Different types of food make proximate composition a bit different and also different part of the body makes the composition different as well. There is lack of information about the nutritional values of different portions of hilsa found in both fresh and marine water. So, the aim of the present study was to determine the proximate composition, salt value and minerals of different portions of fish body from riverine and marine hilsa both raw and salted condition.

Materials and Methods

Study sites and sampling

Riverine hilsa (from Padma river) and marine hilsa fish (from Bay of Bengal) were procured from Sureswar Bazar, Shariatpur (GPS: N- 23°31'22.23"; E- 90°47'05.22") and Fishery Ghat, Chittagong (GPS: N- 22°19'36.2"; E-91°51'38.5"), respectively. The raw fish samples were purchased directly from local fisherman and landing centers during June - July, 2015. The samples were packed in separate polyethylene bags; appropriately labeled, preserved in iced condition (< 4℃) in an insulated Styrofoam box and transported immediately to the laboratory and stored in a freezer (at - 20℃) until required for analysis.

Salted hilsa

The raw fishes were enrolled by dry salt, stacked in containers and stored for a salting or curing period, at room temperature. Then the extracted water of the fishes due to salt action was removed from the container. Thus the fishes were always allowed to remain in dry condition for the production of dry salt cured fish.

Proximate composition

Proximate composition of fish was determined by conventional method of AOAC (2012) on weight basis. However, for moisture determination samples were dried in an oven at about 105°C for about 8 to 10 h. The protein content of the fish was determined by micro kjeldahl method. It involves conversion of organic nitrogen to ammonium sulphate by digestion with concentrated sulphuric acid in a microkjeldahl flask (AOAC, 2012). The ash content of a sample is the residue left after in a muffle furnace at about 550 - 600°C till the residue became white. For the estimation of fat content, the dried samples left after moisture determination were finely grinded and the fat was extracted with a nonpolar solvent, ethyl ether. After extraction, the solvent was evaporated and the extracted materials were weighed (AOAC, 2012).

Salt value

Salt content of the samples were estimated by Mohor method (Alexiyev, 1978). Fillets of fish samples were ground in a mortar with a pastel. The minced fishes were weighed and salt was extracted with distilled water and made into volume of 100 mL and filtered. The filtrate with salt content was titrated.

Minerals value

Calcium (Ca) and iron (Fe) were determined by titration method of Vogel (1978). Determination of phosphorous (P) was carried out following the NIN Manual (1976).

Data analysis

Data analyzed by using the computer software MS Word, Microsoft Office Excel 2007 and XL-stat version 16 for DMRT to understand the differences of the variables.

Results and Discussion

The proximate compositions of fish are moisture, protein, lipids and ash. Fluctuations occur in the proximate composition and minerals are influenced by several factors such as species of fish, fishing grounds, diet, season, sex and also different portions of the body of a species. The Proximate composition and some minerals content of both fresh and salted hilsa in Table 1 and Table 2, respectively.

Nutritional values of raw hilsa

Moisture is the major component of fish muscle. The highest value of moisture (62.11 ± 0.44%) was found in abdominal portion of the Riverine hilsa whereas the lowest value (48.24 ± 0.65%) was in head portion of the Marine hilsa. This result more or less coincides with the findings of Shamim et al. (2011). Moisture was recorded 51.33 ± 0.54%, 59.92 ± 0.56% in the head and caudal portion of riverine hilsa respectively and 60.41 ± 0.46%, 57.42 ± 0.59% in the abdominal portion and caudal portion of the marine hilsa, respectively.

Crude protein was relatively higher in riverine hilsa and the highest value (18.54 ± 0.46%) was in the abdominal portion (Riverine hilsa fish) and the lowest value (10.21 ± 0.52%) was in the head portion (Marine hilsa fish). Protein content was similar to study of Moniruzzaman et al. (2014). According to them the protein content is slightly higher in the flesh of riverine hilsa (19.60%) when compared to Bay of Bengal hilsa (17.20%).

The ash content of the head portion was the highest (17.4 ± 0.41%) of the riverine hilsa and lowest value (1.69 ± 0.05%) was found in the abdominal portion of marine hilsa fish. Moniruzzaman et al. (2014) found the ash content of T. ilisha was of Kirtonkhola river hilsa (2.81%), Meghna river hilsa (2.19%), Payra river hilsa (1.20%) and Marine hilsa (1.10%) which is nearer to the result of ours findings.

In this study highest fat content was estimated in the abdominal region of the marine hilsa (19.07 ± 0.51%) and the lowest value was in the head portion of the riverine hilsa (9.55 ± 0.46%). Marine hilsa fish contains relatively more fat content than riverine hilsa fish. Saha and Guha (1939) on their study estimated 19.4% fat in hilsa which is about to similar to our findings. Shamim et al. (2011) recorded fat content in ventral portion of fish body from the Chittagong region (20.28%) and the lowest was in dorsal

Table 1. Proximate composition and minerals content of raw hilsa fish.

Region	Portion	Proximate parameters (%)					Elemental composition (mg/100 g)		
		Moisture	Protein	Ash	Fat	Salt value	Fe	Ca	P
Riverine	Head region	51.33 ± 0.54b	12.21 ± 0.53b	17.4 ± 0.41a	9.550 ± 0.46b	1.32 ± 0.04a	4.27 ± 0.36a	520.58 ± 4.11a	128.89 ± 3.94a
	Abdominal region	62.11 ± 0.44a	18.54 ± 0.46a	2.04 ± 0.28b	15.41 ± 0.46a	1.09 ± 0.08a	3.17 ± 0.25b	290.68 ± 6.70c	94.760 ± 3.83b
	Caudal region	59.92 ± 0.56a	16.21 ± 0.53a	4.20 ± 0.36b	14.05 ± 0.54a	1.81 ± 0.07a	3.72 ± 0.34b	380.03 ± 7.27b	113.44 ± 5.44a
Marine	Head region	48.24 ± 0.65b	10.21 ± 0.52b	15.24 ± 0.51a	12.61 ± 0.53b	1.83 ± 0.07a	5.66 ± 0.34a	651.76 ± 6.88a	117.39 ± 4.62a
	Abdominal region	60.41 ± 0.46a	17.12 ± 0.42a	1.69 ± 0.05c	19.07 ± 0.51a	1.55 ± 0.29b	4.38 ± 0.32a	376.93 ± 6.11c	82.470 ± 5.32b
	Caudal region	57.42 ± 0.59a	15.22 ± 0.51a	3.82 ± 0.11b	17.48 ± 0.49a	2.02 ± 0.07a	4.73 ± 0.29a	411.36 ± 7.20b	99.790 ± 4.47b

a – c: The values in the same column having similar superscripts did not differ significantly ($p < 0.05$).

Table 2. Proximate composition of salted hilsa fish.

Region	Portion	Proximate parameters (%)					Elemental composition (mg/100 g)		
		Moisture	Protein	Ash	Fat	Salt value	Fe	Ca	P
Riverine	Head region	27.39 ± 0.52c	22.32 ± 0.67b	23.64 ± 0.43a	8.480 ± 0.47b	7.190 ± 0.08b	7.66 ± 0.28a	820.85 ± 5.95a	157.55 ± 1.44a
	Abdominal region	42.81 ± 0.51a	32.54 ± 0.50a	16.31 ± 0.07b	11.58 ± 0.39a	10.49 ± 0.26a	3.39 ± 0.60b	415.75 ± 7.06c	114.49 ± 1.40b
	Caudal region	37.50 ± 0.49b	30.21 ± 0.49a	18.39 ± 0.47b	10.14 ± 0.40a	11.74 ± 0.15a	5.10 ± 0.08a	647.13 ± 7.29b	133.79 ± 2.32b
Marine	Head region	25.65 ± 0.43c	18.20 ± 0.55b	22.71 ± 0.25a	9.730 ± 0.41b	11.41 ± 0.30b	8.83 ± 0.39a	980.65 ± 3.61a	138.52 ± 2.08a
	Abdominal region	41.13 ± 0.45a	27.31 ± 0.48a	15.20 ± 0.23b	13.60 ± 0.55a	14.70 ± 0.41b	4.55 ± 0.51b	576.18 ± 4.80c	97.390 ± 1.15c
	Caudal region	35.82 ± 0.52b	26.28 ± 0.46a	16.54 ± 0.39b	10.99 ± 0.39b	16.46 ± 0.58a	5.48 ± 0.54b	720.74 ± 3.62b	127.49 ± 2.08b

a – c: The values in the same column having similar superscripts did not differ significantly ($p < 0.05$).

portion of fish body from the Khulna region (18.65%).There was very little amount of salt content and it was relatively higher in marine hilsa fish than riverine hilsa fish. The highest value of salt content was calculated in the caudal portion of marine hilsa (2.02 ± 0.07%) and the lowest value was in the abdominal portion of riverine hilsa (1.09 ± 0.08%).

Among minerals, Fe (5.66 ± 0.34%) and Ca (651.76 ± 6.88%) was remain in large amount at head portion of marine hilsa but P content (128.89 ± 3.94%) was remain high level in riverine hilsa. Elemental composition was founded at a low level in the abdominal part of both fishes. Mineral composition of the fresh hilsa fish correlated with the findings of Mohanty et al. (2012). It was observed that except the moisture and fat content the other nutrients were higher in salted hilsa than that of fresh ones.

Nutritional values of salted hilsa

The moisture contents decreased significantly ($p < 0.05$) from fresh fish to salted fish (Table 1 and Table 2). During salting, moisture is rapidly removed from the fish as well as salt penetrated in to the flesh (Clucas, 1982). The highest value was recorded at abdominal portion (42.81 ± 0.51% for riverine and 41.13 ± 0.45% for marine) and lowest value was in the head portion (27.39 ± 0.52% for riverine and 25.65 ± 0.43% for marine) of both marine and riverine hilsa fishes. Rohomania et al. (2014) estimated higher moisture in dorsal portion (45.13 ± 0.54%) of salted hilsa than that of ventral (40.20 ± 0.20%) which is nearer to ours findings.

The protein contents are also increased significantly in salted hilsa than that of fresh ones. This might be due to the denaturation of proteins, increase of free amino acids and other forms of non-proteinous nitrogen in the muscle tissue of the fish (Mustafa et al., 2012). Highest protein value (32.54 ± 0.5%) was calculated at abdominal portion of riverine hilsa the lowest value (18.2 ± 0.55%) was in the head portion of marine hilsa fishes. Mustafa et al. (2012) estimated the protein content (34.93 ± 0.45%) of dry salted hilsa fish which is a little far from our aestivation.

The ash content was increased significantly after salting and high value of ash content was founded at head portion than other parts of the body (both riverine and marine hilsa) due to the bony part. Majumdar et al. (2004) found ash content 16.73% in muscle of 'lonailish' (salted hilsa) where ash content agreed with ours.

In hilsa fish, the fat content decreased after salting. As hilsa is a fatty fish, after salting a significant amount of fat may be leached out in the self - brine (Jacquot, 1961). Crude fat was calculated as a high level (13.6 ± 0.55%) in the abdominal portion of marine hilsa and low level (8.48 ± 0.47%) in the head portion of riverine hilsa. Majumdar et al. (2004) studied the lipid content (16.90 ± 0.79%) of 'lonailish' which is greater value than our findings.

Salt accumulation was at higher level at caudal portion of both marine and riverine fish and 16.46 ± 0.58% salt was calculated in the caudal portion of marine hilsa that was similar to the findings (15.48 ± 1.21%) of Majumdar et al. (2004).

Highest Fe and Ca were calculated as 8.83 ± 0.39%, 980.65 ± 3.61% in the head portion of marine hilsa and the highest level of P was estimated as 157.55 ± 1.44% in the head region of riverine hilsa fish.

Mustafa et al. (2012) studied the minerals content of dry salt hilsa (Fe = 1.05 ± 0.19%; Ca = 113.804 ± 2.00%; P = 193.85 ± 1.76%) which were differ from the present study.

Conclusion

The nutritional composition of hilsa varies habitat to habitat. In this study, we found that nutritional value such as protein was higher in riverine hilsa whereas, fat and minerals value was higher in marine hilsa both raw and salted condition. While our findings are novel, further research is needed in different seasons of hilsa to quantify the nutritional composition of riverine and marine hilsa.

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